EMS Annual Meeting Abstracts
Vol. 16, EMS2019-71, 2019

Automatic Identification and Classification of the Red-Sea Trough and its Application for Climatological Analysis

Baruch Ziv (1), Hadas Saaroni (2), Tzvi Harpaz (1,2)

(1) The Open University of Israel, Department of Natural Sciences, Ra'anana, Israel (zivbaruchana@gmail.com), (2) Tel-Aviv University, Porter School of the Environment and Earth Sciences, Tel Aviv, Israel (saaroni@tauex.tau.ac.il)

The Red Sea Trough (RST) is a low-pressure system extending from south toward the Eastern Mediterranean (EM) and further to the Levant. This system is the most frequent among all easterly troughs, which extend from the east African Monsoon toward the EM, and is attributed to the lee effect of mountain ridges along the Red Sea. Unlike previous synoptic classifications covering all systems that affect the region, our algorithm focuses on the RST alone. It uses sea-level pressure (SLP) and geostrophic vorticity for identifying the existence of a RST and for classifying it to one of 3 types, according to the location of the trough axis with respect to 35[U+F0B0]E longitude, i.e. to the west of Israel, to the east or within Israel. The following conditions were imposed to assure the existence of a RST: (i) north to south SLP decrease across the Levant, (ii) average positive vorticity over the Levant, (iii) existence of a distinct and continuous trough axis from the low pressure toward the Levant and (iv) the absence of any pronounced closed cyclone near the Levant (which is not a meso-cyclone within the RST). The algorithm was applied on the NCEP/NCAR reanalysis, $2.5^\circ \times 2.5^\circ$ resolution and the ERA Interim, $2.5^\circ \times 2.5^\circ$ and $0.75^\circ \times 0.75^\circ$ resolutions. A subjective evaluation of our algorithm showed a 92% skill of RST identification and 79% skill of the classification of one of the three above-mentioned types.
The analysis confirms that the autumn is the main season of RST, with a maximum in November and a gradual and consistent decrease, fading out by mid-spring with an annual minimum, of close to zero, during the summer. The annual average frequency varies among the data sources between 18% and 25%. These values agree with the semi-objective synoptic classification of Alpert et al. (2004) for the Levant, who identified 19% of the days of the year as 'RST days'. The trough axis is shown to have a diurnal oscillation; toward the eastern coast of the Mediterranean at nighttime (00UTC) and eastward, inland, at noontime (12UTC). No consistent long-term trend in the occurrence of RST was found for the period 1979-2016, during which the global warming was persistent.
This fully automated algorithm is not confined to any predetermined spatial resolution, and is applicable to a variety of reanalysis datasets, operational forecast models as well as to climate model outputs.